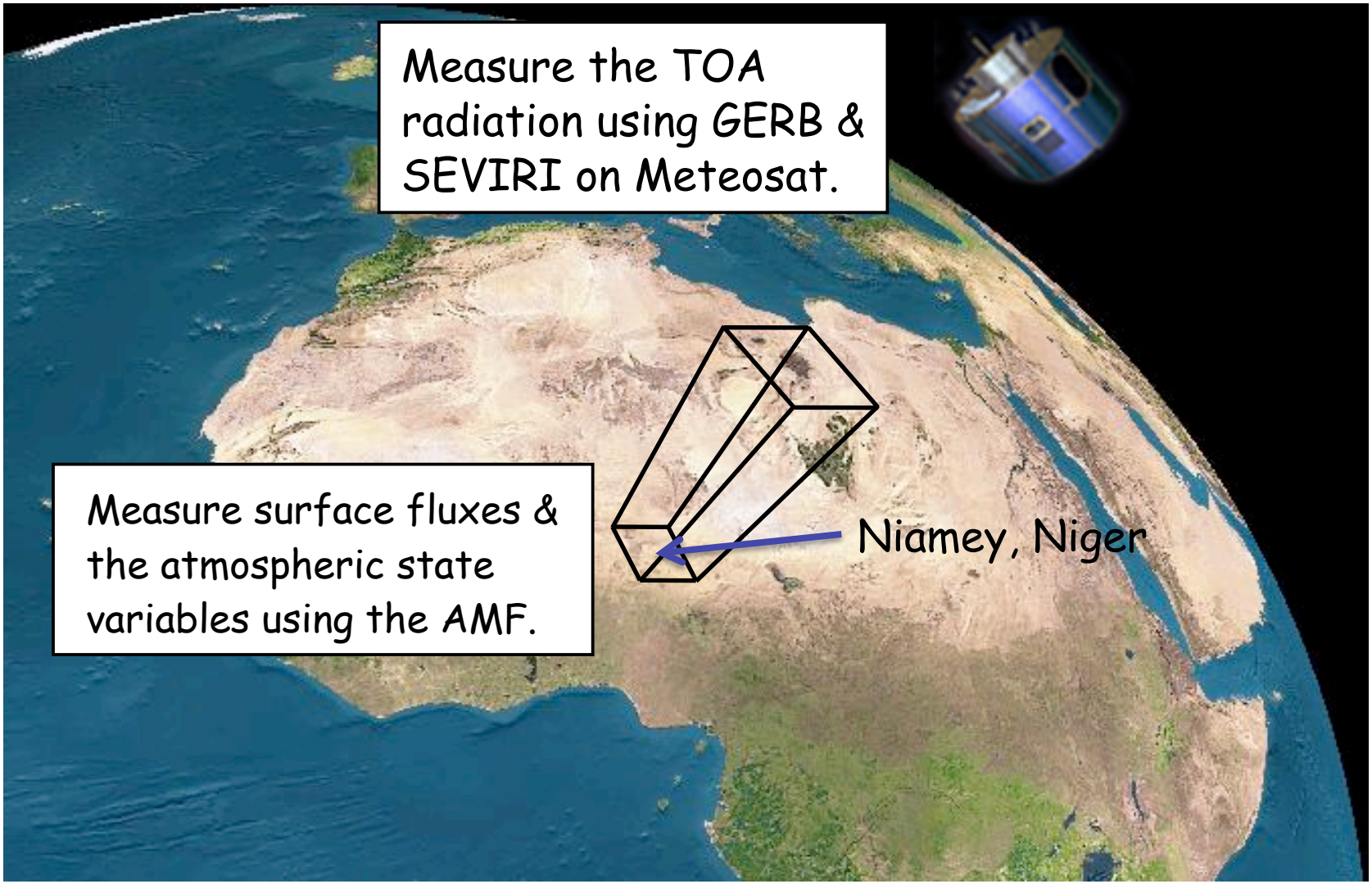
On the performance of the IPCC and NCAR climate models in West Africa

Mark Miller, Virendra Ghate, Robert Zahn


Measure the TOA radiation using GERB & SEVIRI on Meteosat.
Measure surface fluxes & the atmospheric state variables using the AMF.
Niamey, Niger

Model Run Descriptions

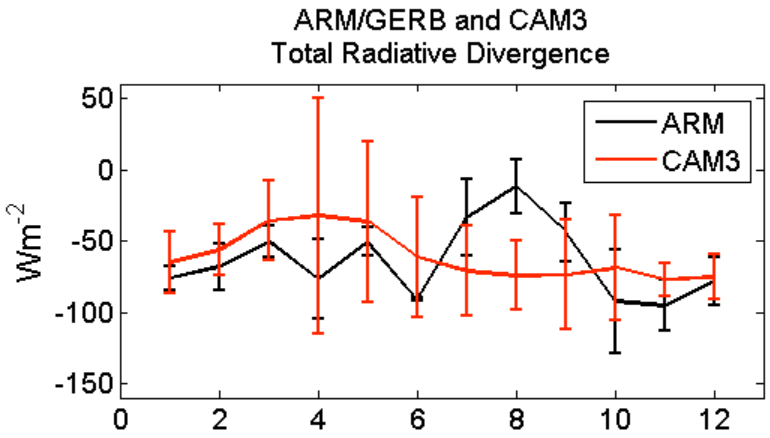
- **HADGEM1**
  - *UK Met Office Hadley Center*
  - Experiment ID = 1% per year CO2 increase experiment (to doubling), run 2
  - Single Level Grid Size = 1.25 Latitude by 1.875 Longitude (145 by 192 grid)
  - Multi Level Grid Size = 1.25 Latitude by 1.875 Longitude by 16 Pressure Levels

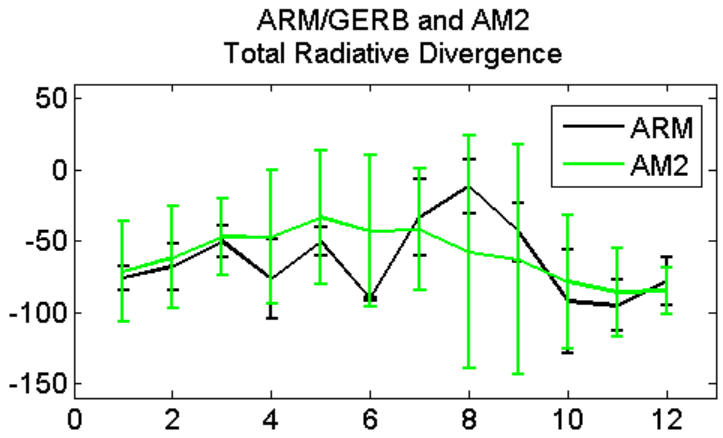
- **AM2.1 (CM2.1)**
  - *NOAA Geophysical Fluid Dynamics Laboratory*
  - Experiment ID = 1% per year CO2 increase experiment (to doubling), run 1
  - Grid Size = 2 Latitude by 2.5 Longitude by 17 Pressure Levels

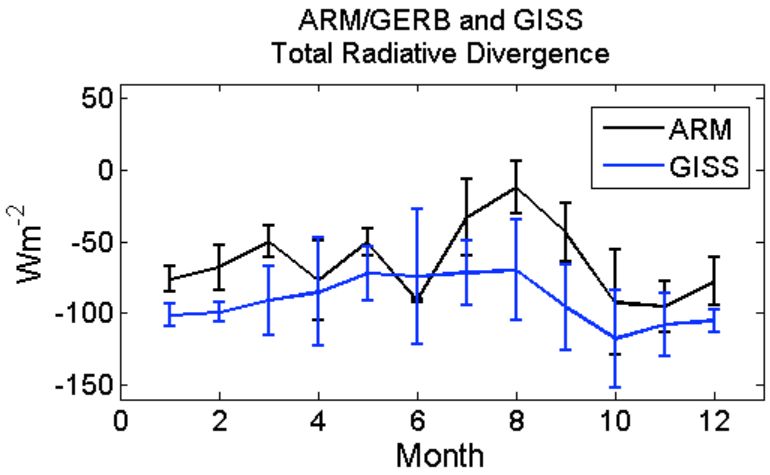
- **GISS Model E**
  - *NASA Goddard Institute for Space Studies*
  - Experiment ID = 1% per year CO2 increase experiment (to doubling), run 1
  - Single Level Grid Size = 3 Latitude by 5 Longitude
  - Multi-Level Grid Size = 4 Latitude by 5 Longitude by 17 Pressure Levels

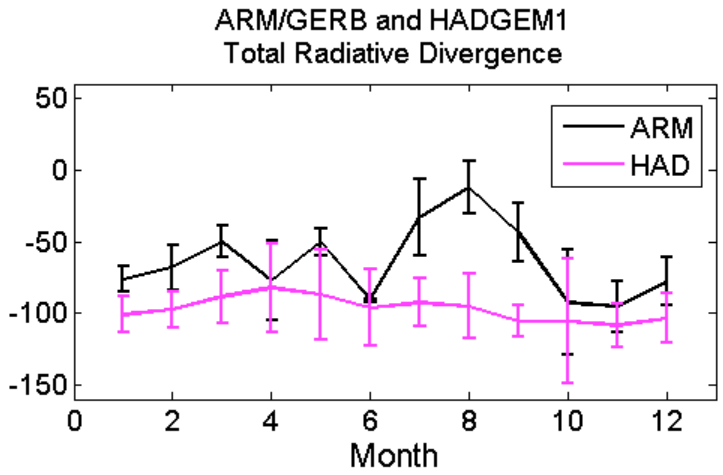
- **CAM3 (CCSM3.0)**
  - *National Center for Atmospheric Research*
  - Experiment ID = 720ppm Stabilization Experiment (SRESA1B), run 1
  - Single Level Grid Size = 1.4 Latitude by 1.4 Longitude

- Data Access
  - CAM3, HADGEM1, and GISS Model E wind components accessed from the PCMDI CMIP3 Data Portal. All other GISS data accessed directly from the Goddard Institute for Space Studies FTP, directory ModelE-h2b. All AM2.1data accessed from the GFDL Data Portal

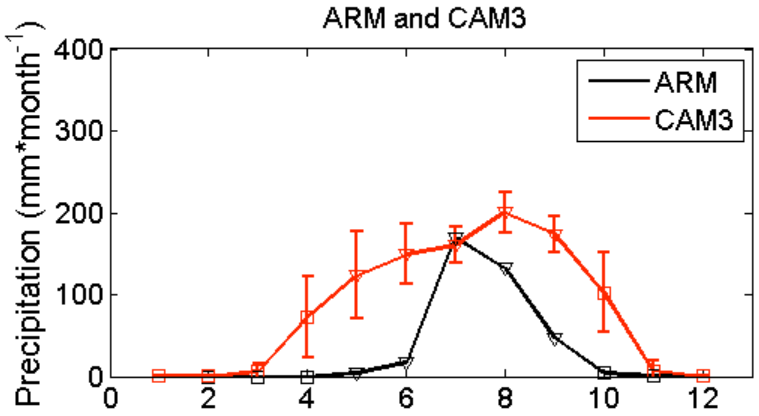

ARM/GERB and CAM3
Total Radiative Divergence
ARM
CAM3
Wm-2
50
0
-50
-100
-150
0
2
4
6
8
10
12

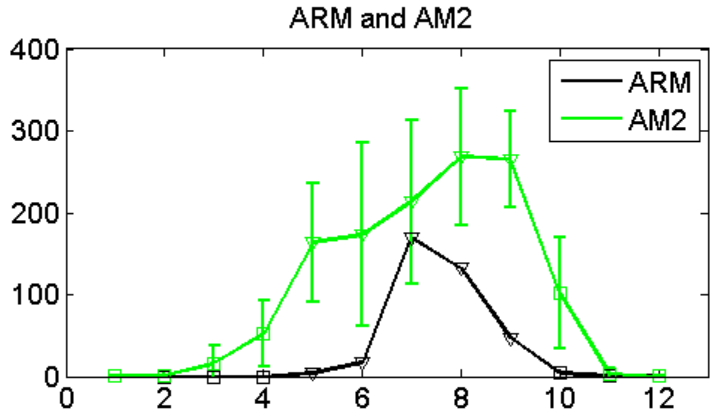

ARM/GERB and AM2
Total Radiative Divergence
ARM
AM2
50
0
-50
-100
-150
0
2
4
6
8
10
12

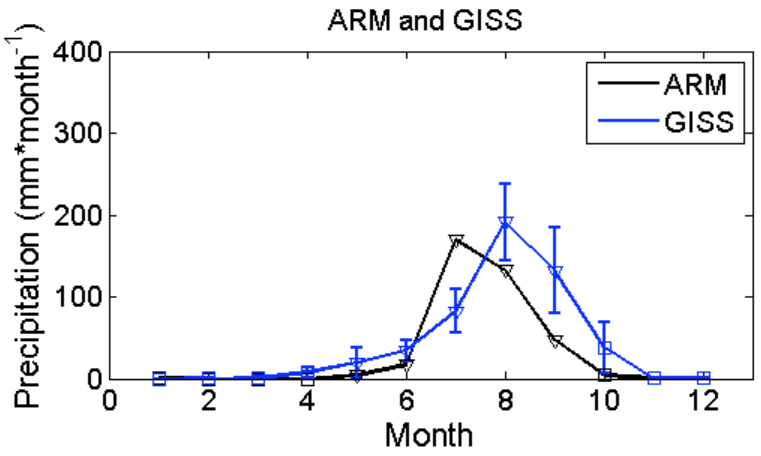

ARM/GERB and GISS
Total Radiative Divergence
ARM
GISS
Wm-2
50
0
-50
-100
-150
0
2
4
6
8
10
12
Month

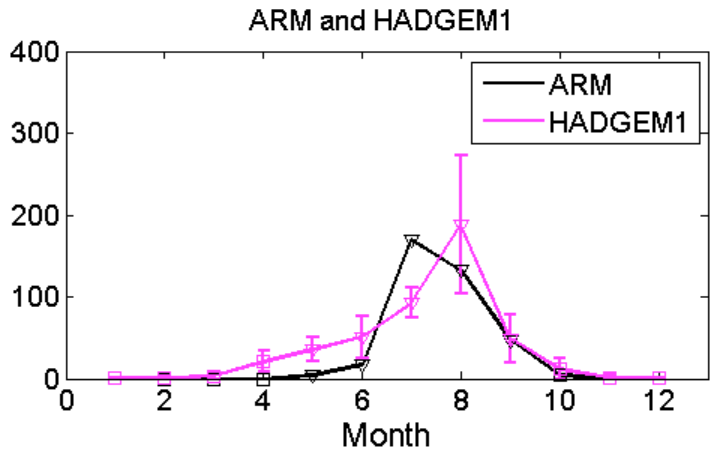

ARM/GERB and HADGEM1
Total Radiative Divergence
ARM
HAD
50
0
-50
-100
-150
0
2
4
6
8
10
12
Month

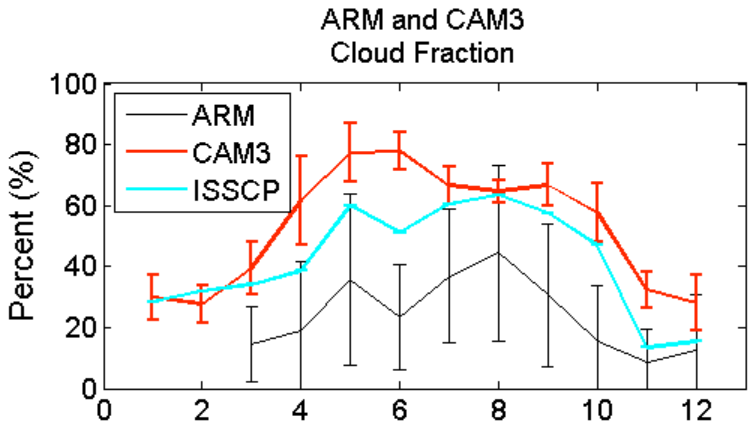
GCM	10-year mean Net Radiative Flux Divergence
CAM3	-60.7
AM2	-59.9
GISS	-91.1
HadGEM1	-97.1
ARM/GERB 2006	-64.1

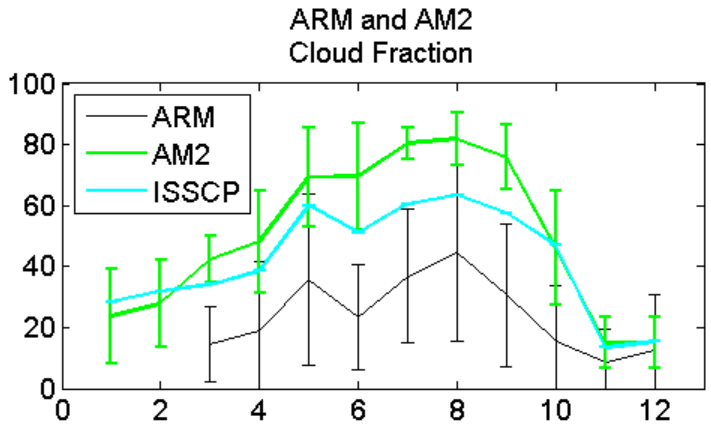

ARM and CAM3
Precipitation (mm*month^{-1})
ARM
CAM3
0
100
200
300
400
0
2
4
6
8
10
12

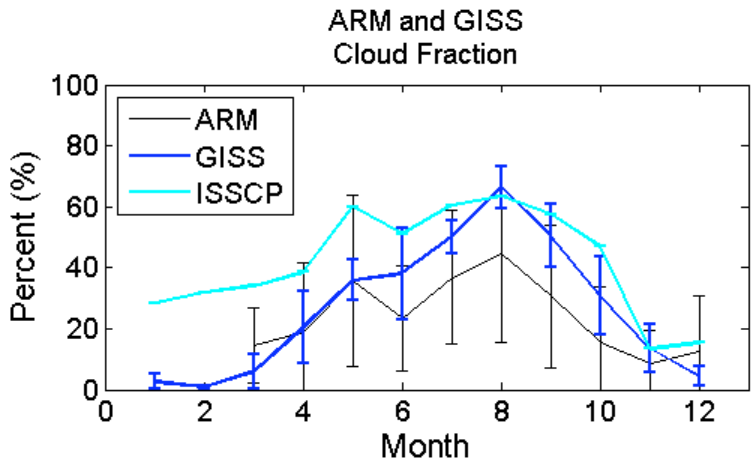

ARM and AM2
ARM
AM2
0
100
200
300
400
0
2
4
6
8
10
12

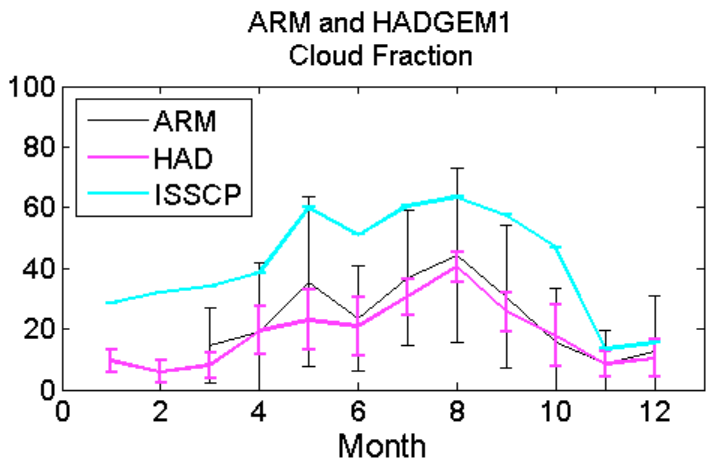

ARM and GISS
Precipitation (mm*month^{-1})
ARM
GISS
0
100
200
300
400
0
2
4
6
8
10
12
Month

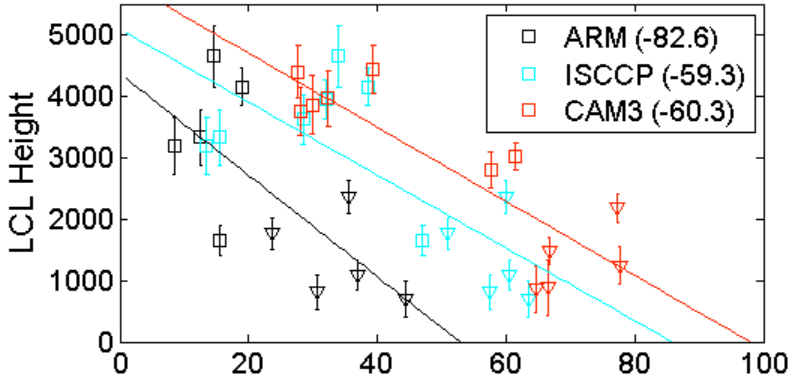

ARM and HADGEM1
ARM
HADGEM1
0
100
200
300
400
0
2
4
6
8
10
12
Month

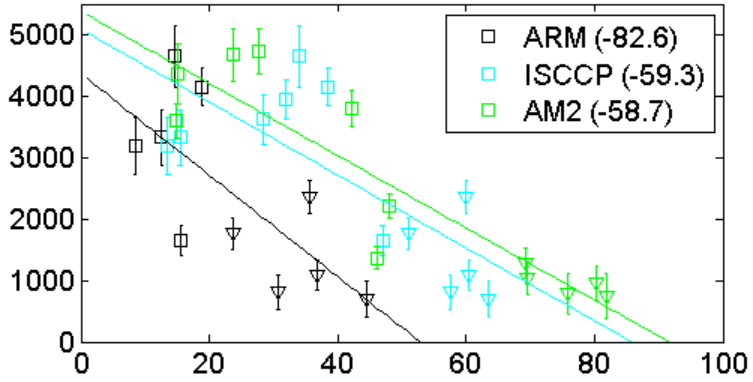

ARM and CAM3
Cloud Fraction
Percent (%)
ARM
CAM3
ISSCP
0
20
40
60
80
100
0
2
4
6
8
10
12

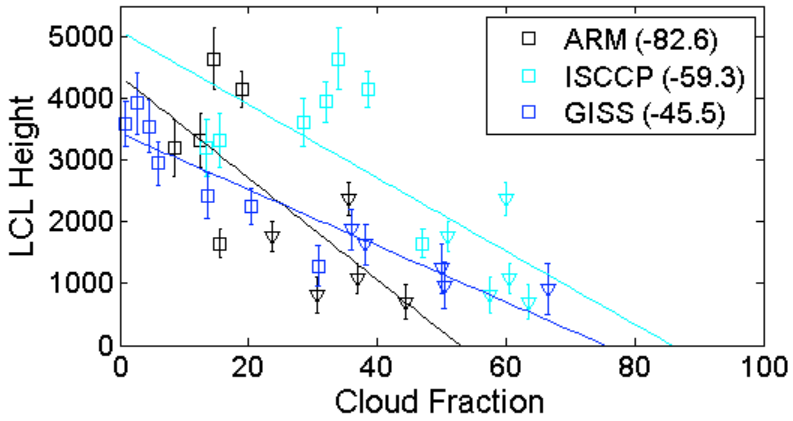

ARM and AM2
Cloud Fraction
ARM
AM2
ISSCP
0
20
40
60
80
100
0
2
4
6
8
10
12

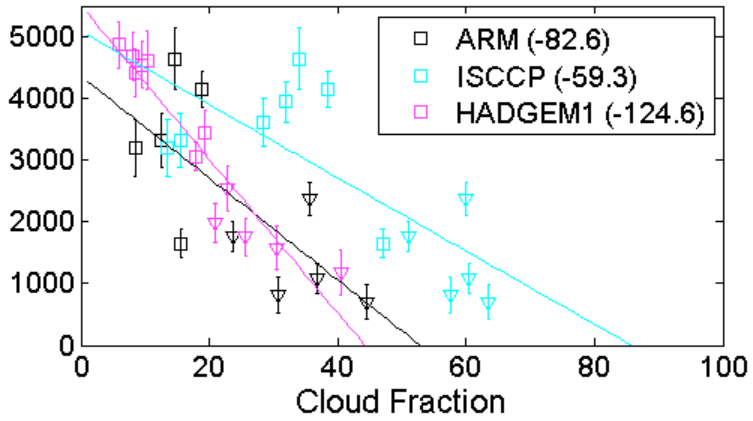

ARM and GISS
Cloud Fraction
Percent (%)
ARM
GISS
ISSCP
0
20
40
60
80
100
0
2
4
6
8
10
12
Month

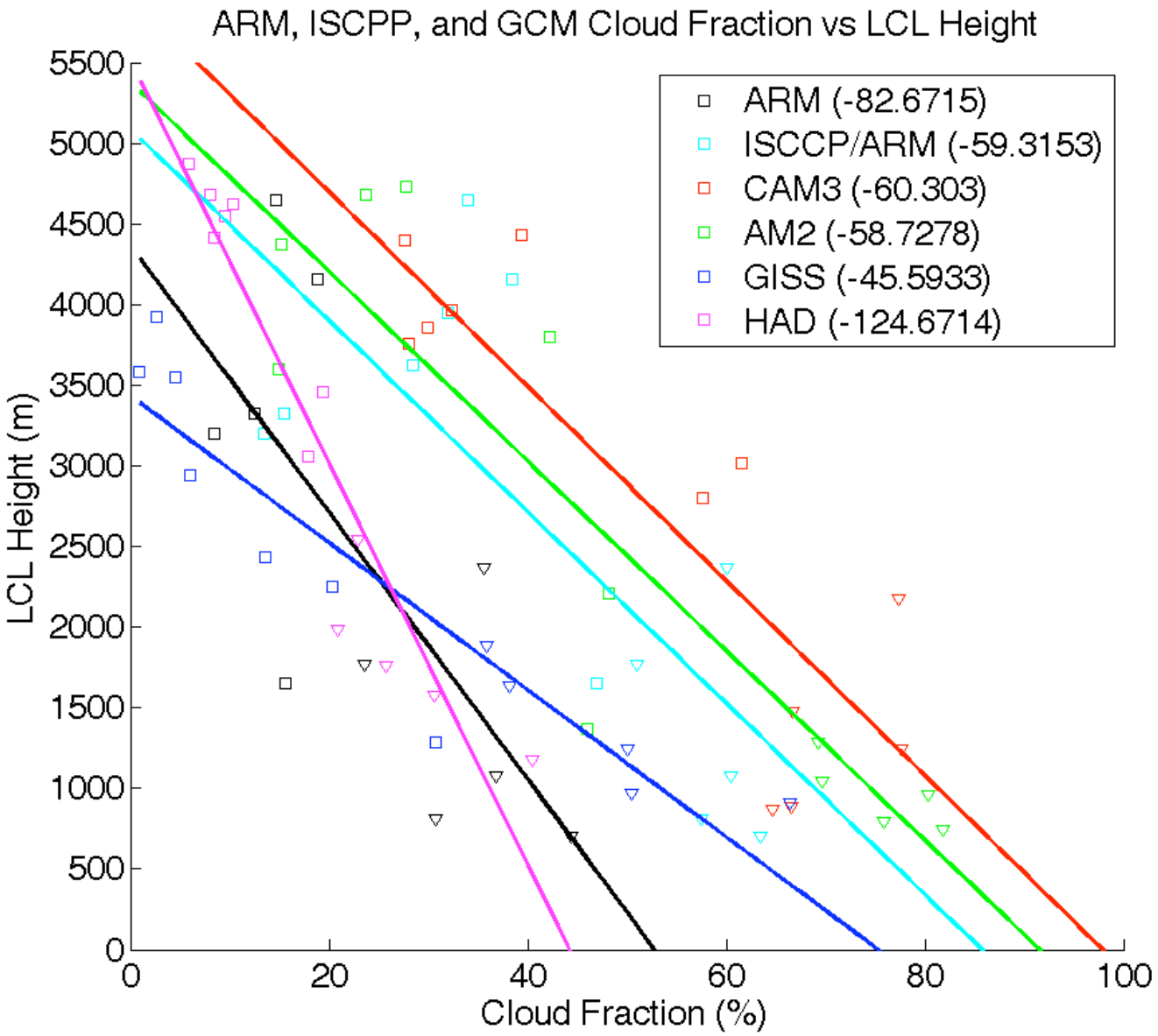

ARM and HADGEM1
Cloud Fraction
ARM
HAD
ISSCP
0
20
40
60
80
100
0
2
4
6
8
10
12
Month


LCL Height
5000
4000
3000
2000
1000
0
0
20
40
60
80
100
ARM (-82.6)
ISCCP (-59.3)
CAM3 (-60.3)


5000
4000
3000
2000
1000
0
0
20
40
60
80
100
ARM (-82.6)
ISCCP (-59.3)
AM2 (-58.7)


LCL Height
5000
4000
3000
2000
1000
0
0
20
40
60
80
100
Cloud Fraction
ARM (-82.6)
ISCCP (-59.3)
GISS (-45.5)


5000
4000
3000
2000
1000
0
0
20
40
60
80
100
Cloud Fraction
ARM (-82.6)
ISCCP (-59.3)
HADGEM1 (-124.6)


ARM, ISCPP, and GCM Cloud Fraction vs LCL Height
ARM (-82.6715)
ISCCP/ARM (-59.3153)
CAM3 (-60.303)
AM2 (-58.7278)
GISS (-45.5933)
HAD (-124.6714)
LCL Height (m)
Cloud Fraction (%)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
0
20
40
60
80
100

Summary

- Model performance in the Sahel Region depends on the metric
  - Radiation: CAM3 and AM2
  - Clouds and Precipitation: GISS and HadGEM1
- ISCCP likely overestimates high cloudiness and underestimates convective cloudiness over Niamey in 2006
- AMF likely underestimates high cloudiness and the depth of deep precipitating clouds.
  - Dry lower atmosphere helps AMF
- Tuning to ISCCP evident in CAM3 and AM2
- Lot's more to do—need more data from ARM/GERB combination ☺